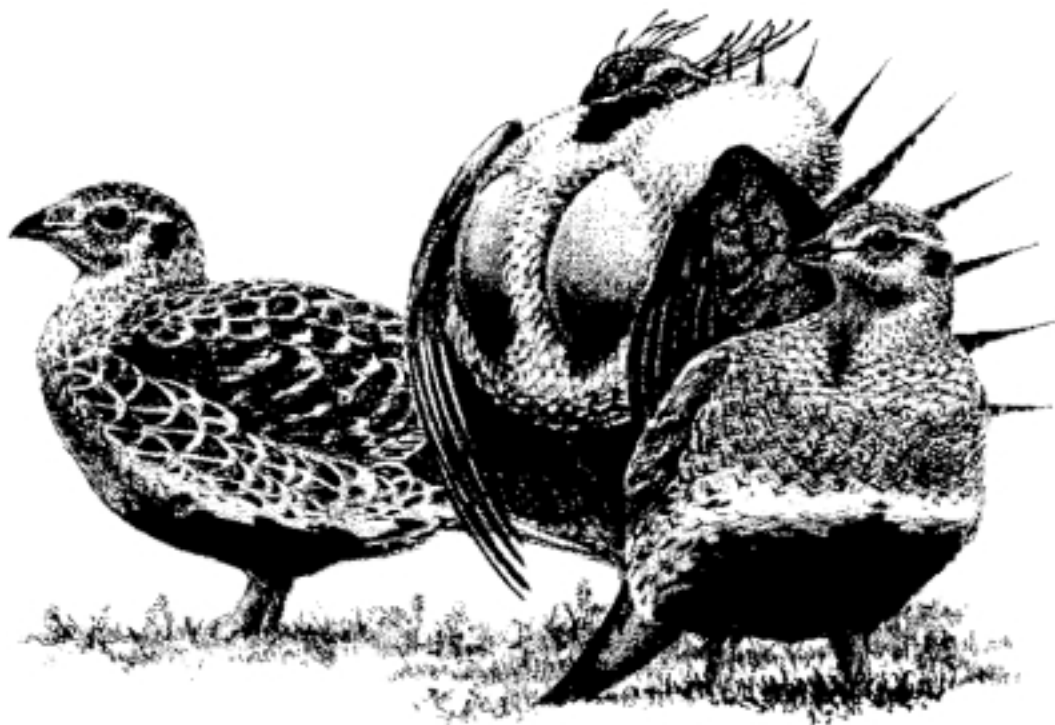


Greater Sage-Grouse and Sagebrush-Steppe Ecosystems Management Guidelines



August 21, 2000

Authorship

These management guidelines are the product of an interagency, interdisciplinary sage-grouse planning team, including:

Bureau of Land Management

Hugh Barrett, Range Conservationist, Oregon State Office
Erick G. Campbell, Wildlife Biologist, Oregon State Office
Steve Ellis, District Manager, Lakeview District, Oregon
Jan Hanf, Wildlife Biologist, Prineville, Oregon
Roy Masinton, Field Manager, Vale, Oregon
Jolie Pollet, Fire Ecologist, Lakeview, Oregon
Terry Rich, Avian Ecologist, Boise, Idaho
Jeff Rose, Fire Ecologist, Burns, Oregon
Jon Sadowski, Wildlife Biologist, Vale, Oregon
Fred Taylor, Wildlife Biologist, Burns, Oregon
Peter Teensma, Fire Ecologist, Portland, Oregon

U. S. Fish and Wildlife Service

Jeff Dillon, Wildlife Biologist, Portland, Oregon

U.S. Forest Service

David Zalunardo, Wildlife Biologist, Prineville, Oregon

Oregon Department of Fish and Wildlife

Brad Bales, Waterfowl/Upland Game Bird Manager, Portland, Oregon
Walt Van Dyke, Wildlife Biologist, Ontario, Oregon

Oregon Department of State Lands

Nancy Pustis, Eastern Oregon Manager, Bend, Oregon



Sage Grouse

Table of Contents

INTRODUCTION	1
SAGE-GROUSE LIFE HISTORY	3
Population Biology	3
Overview of life history	3
Reproduction	3
Nesting rates	3
Nest success	3
Clutch size	3
Survival rates	3
Habitat Requirements	4
Seasonal movements and home range	4
Breeding habitats.	4
Brood-rearing habitats	5
Winter habitats	5
CURRENT SAGE-GROUSE SITUATION	6
Status of Sage-Grouse	6
Threats to the Species	6
Agricultural conversion	6
Rangeland conversion	6
Livestock management	6
Wildfire and prescribed fire	7
Fire rehabilitation	7
Structures	7
Juniper expansion	7
Exotic invasive plants	8
Wild horses	8
MANAGEMENT GOALS AND OBJECTIVES	9
Conservation Goals by Habitat	9
Objectives	10
SAGE-GROUSE AND SAGEBRUSH-STEPPE MANAGEMENT GUIDELINES	10
Management Actions	11
IMPLEMENTATION MONITORING	16
LITERATURE CITED	18

MANAGEMENT GUIDELINES FOR GREATER SAGE-GROUSE & SAGEBRUSH-STEPPE ECOSYSTEMS

Introduction

These management guidelines and the supporting background information are intended to promote the conservation of greater sage-grouse (*Centrocercus urophasianus*) and their sagebrush (*Artemisia spp*) habitats on Oregon and Washington public lands administered by the Bureau of Land Management (BLM). These guidelines establish interim policy while we complete our long-term Sage-Grouse/Sagebrush-Steppe Conservation Assessment and Plan. These guidelines are tied to the life history of sage-grouse and respond to the best science available on the management of sage-grouse. They are intended to preserve options, but not constrain strategies being explored for the long-term conservation strategy.

Sage-grouse populations have exhibited long-term declines throughout North America, declining by 33 percent over the past 30 to 40 years (Braun 1998). The species has been extirpated in five states and one Canadian province, and is “at risk” in six other states and two Canadian provinces. Even in the five Western states where the species is considered to be more abundant, long-term population declines have averaged 30 percent (see Maps 1 and 2) (Connelly and Braun 1997, Crawford and Lutz 1985). Various factors affecting sage-grouse populations occur at different temporal and spatial scales. No single causal factor has been identified for these declines. Instead, an accumulation of factors described herein are responsible.

Although these guidelines focus on conservation of sage-grouse, many of the guidelines benefit conservation needs of other sagebrush-steppe species of concern (Wisdom et al. in press). The long-term “Sage-Grouse/Sagebrush-Steppe Conservation Assessment and Plan” will focus on sage-grouse, as well as other sagebrush-steppe species of concern identified in Wisdom et al. (in press), which is the terrestrial vertebrate science assessment used in the Supplemental Draft Environmental Impact Statement (EIS) for the *Interior Columbia Basin Ecosystem Management Project (ICBEMP)*. ICBEMP will provide an integrated strategy and an analytical framework to assist federal land managers develop the long-term sage-grouse strategy. These management guidelines are consistent with the step-down process outlined in ICBEMP.

Two other policies also direct these management guidelines:

1. BLM National Policy on Special Status Species (BLM 6840 Manual) states: “BLM shall carry out management, consistent with the principles of multiple use, for the conservation of candidate [and sensitive] species and their habitats and shall ensure that actions authorized, funded, or carried out do not contribute to the need to list any of these species as threatened/endangered.”
2. These guidelines are consistent with the *OR/WA Standards for Rangeland Health*. The BLM is committed to achieving healthy rangelands in Oregon and Washington. Standard 5 states “Habitats support healthy, productive and diverse populations and communities of native plants and animals (including special status species and species of local importance) appropriate to soil, climate and land form.” The BLM grazing regulations (43 CFR 4180.2 [c]) state: “The authorized officer shall take appropriate action as soon as practicable but not later than the start of the next grazing year upon determining that existing grazing management practices or levels of grazing use on public lands are significant factors in failing to achieve the standards and conform with the guidelines that are made effective under this section.”

Tailoring management of livestock grazing to site-specific conditions in the attainment of Standard 5 is critical to the success of this strategy, as well as future species/ecosystem recovery strategies. Designing and applying management prescriptions that address site-specific conditions is the responsibility of field offices in consultation, cooperation, and communication with effective interests. In addition, current priorities and schedules for implementing BLM's

Healthy Rangeland Initiatives may require modifications based on the current condition of sage-grouse habitat and the risk of further habitat loss.

Matters related to falconry and hunting are not the purview of the BLM, but are instead administered by the Oregon Department of Fish and Wildlife or Washington Department of Fish and Wildlife. These management guidelines are intended to apply only to BLM-administered activities on BLM public lands.

SAGE-GROUSE LIFE HISTORY

Population Biology

Overview of life history. The breeding of sage-grouse begins in mid-March when the males start to congregate on the leks. Leks are the breeding or strutting grounds. Females come to the leks to mate and generally nest in the vicinity. A high proportion of nests are located within 6.2 kilometers (km) or 4 miles (mi.) of the lek when suitable nesting habitat exists. However, some studies have shown that female sage-grouse or hens nest as far as 20 km (12 mi.) away from the lek (Autenrieth 1981, Wakkinen et al. 1992). After hatching her young, a hen keeps her brood in the general vicinity of the nest for 1 or more weeks. For the first 3 to 4 weeks after hatching, chicks feed primarily on insects, which provide the high protein diet needed for rapid growth. As the season and plant phenology progresses, hens move their broods to higher elevation habitats or to more moist habitats, such as meadows, where higher quality foods are available.

Forbs (herbaceous plants other than grass) are an important food to sage-grouse. As forbs mature and dry out and insect availability declines with the advance of summer, the sage-grouse diet includes more sagebrush leaves and buds. During late fall, sage-grouse feed almost exclusively on sagebrush. They continue to forage on sagebrush throughout the winter until forbs reappear the following spring. Because of their dependence on sagebrush, the birds are commonly referred to as “sagebrush obligates.” For this reason, there is much concern about the condition and distribution of sagebrush habitats.

Reproduction. Sage-grouse generally have lower reproductive rates and higher annual survival rates than other species of upland game birds, such as quail and partridge (Connelly and Braun 1997). They also live longer than most upland gamebird species; individual birds 4 to 5 years old are common. Annual reproductive success varies throughout the species' range (Gregg 1991, Wallestad and Pyrah 1974).

Nesting rates. Nesting rates vary from year to year and from area to area (Bergerud 1988, Coggins 1998, Connelly et al. 1993, Gregg 1991, and Schroeder 1997). This variation is most likely a result of the quality of available nutrition and the general health of pre-laying females (Barnett and Crawford 1994). At least 70 percent of the females in a population will initiate a nest each year, with higher nest initiation rates recorded during years of higher precipitation in comparison to periods of drought (Coggins 1998). Renesting rates by females who have lost their first clutch are 10 to 40 percent, which is far lower than other upland game birds (Bergerud 1988, Connelly et al. 1993, Eng 1963, Patterson 1952, and Petersen 1980). Renesting may do little to increase overall population numbers.

Nest success. Nest success of sage-grouse also varies by year and area. Of all the birds that nest, 10 to 86 percent produce chicks (Connelly et al. 1993, Gregg 1991, Schroeder 1997, and Trueblood 1954). Adult females may experience higher success rates than yearling females (Wallestad and Pyrah 1974), a characteristic that may be related to past nesting experience.

Clutch size. The clutch size (nest of eggs) of sage-grouse is variable and relatively low compared to other species of game birds (Edminster 1954, Schroeder 1997). Clutch size per nest normally ranges from seven to ten eggs (Connelly unpub., Schroeder 1997, Wakkinen 1990). These differences may be related to habitat quality and overall condition of pre-laying females (Coggins 1998).

Survival rates. Annual survival rates for yearling and adult sage-grouse vary from 35 to 85 percent for females, and from 38 to 54 percent for males (Connelly et al. 1994, Wallestad 1975, and Zablan 1993). Lower survival rates for males may be related to the higher predation rates on males during the lekking season (Swenson 1986).

A stable sage-grouse population is largely dependent on the level of production of young, clutch size, nest success, chick survival, and adult survival. Among western states, long-term juvenile to hen ratios have varied from 1.40 to 2.96 juveniles per hen in the fall. In recent years, this ratio has declined to 1.21 to 2.19 juveniles per hen. Research suggests that at least 2.25 juveniles per hen should be present in the fall population to allow for stable to increasing sage-grouse populations

(Compton and Connelly unpub., Connelly and Braun 1997, Edelman et al. 1998).

Habitat Requirements

Seasonal movements and home range. Sage-grouse populations can be migratory or nonmigratory (resident) (Beck 1975, Berry and Eng 1985, Connelly et al. 1988, Fischer 1994, Wakkinen 1990, and Wallestad 1975), depending on location and associated land form. Where topographic relief allows, sage-grouse generally move to higher elevations from spring through fall as snow melts and plant growth advances. Nonmigratory populations may spend the entire year within an area of 100 km² (38.61 mi.²) or less in size. In migratory populations, seasonal movements may exceed 75 km (46.5 mi.) (Connelly et al. 1988, Dalke et al. 1963), and home ranges may exceed 1,500 km² (579 mi.²) (Connelly unpub. data). There may be two or more seasonal ranges in such cases. For example, there may be a breeding range, a brood-rearing range, and a winter range, indicating that migratory sage-grouse populations depend on large expanses of habitat.

To accommodate these habitat needs, it is important to identify sage-grouse movement patterns and seasonal ranges before planning management actions such as vegetation treatment projects that could have irreversible impacts. Suitable habitat may be needed to allow for connectivity among the different resident populations. Connectivity promotes genetic exchange and reduces complications that may arise from inbreeding.

Breeding habitats. Sage-grouse breed on sites called leks (strutting grounds). The same lek sites tend to be used year after year. They are established in open areas surrounded by sagebrush, which is used for escape and protection from predators (Gill 1965, Patterson 1952). Examples of lek sites include landing strips; old lake beds or playas; low sagebrush flats; openings on ridges; roads; crop land; and burned areas (Connelly et al. 1981, Gates 1985). As grouse populations decline, the number of males attending leks may decline or the use of some leks may be discontinued. Likewise, as populations increase, male attendance on leks increases, new leks may be established, or old leks may be reoccupied. Annual counts of males on leks are used to assess population trends.

The lek is considered the center of year-round activity for resident grouse populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1974). However, habitats that are located large distances from the leks are used by migratory populations of sage-grouse and are essential to their survival (Connelly et al. 1988, Wakkinen et al. 1992). On the average, most nests are located within 6.2 km (4 mi.) of the lek; however, some females or hens may nest more than 20 km (12 mi.) away from the lek (Autenrieth 1981, Fischer 1994, Hanf et al. 1994, Wakkinen et al. 1992).

Habitats used by pre-laying hens are also part of the general breeding habitat. These areas provide forbs that are high in calcium, phosphorus, and protein, all of which are necessary for egg production. The condition and availability of these areas are thought to have a significant effect on reproductive success (Barnett and Crawford 1994, Crawford pers. comm.). Most sage-grouse nests are located under sagebrush plants (Gill 1965, Gray 1967, Patterson 1952, Schroeder et al. 1999, Wallestad and Pyrah 1974); however, nests have been found under other plant species (Connelly et al. 1991, Gregg 1991). Sage-grouse that nest under sagebrush experience higher nest success (53 percent) than those nesting under other plant species (22 percent) (Connelly et al. 1991). Studies on sage-grouse nesting habitat have documented that sage-grouse tend to select nest sites under sagebrush plants that have large canopies. The canopies provide overhead cover and often correlate with an herbaceous (primarily grasses) understory, which provides lateral cover and assists birds in hiding from predators (DeLong et al. 1995, Fischer 1994, Gregg 1991, Gregg et al. 1994, Gray 1967, Klebenow 1969, Patterson 1952, Wakkinen 1990, Wallestad and Pyrah 1974). Hens nesting in these cover conditions

experience higher nest success rates than those nesting under inferior cover conditions (Delong et al. 1995, Wallestad and Pyrah 1974).

Optimum sage-grouse nesting habitat consists of the following: sagebrush stands containing plants 40 to 80 cm (16 to 32 in.) tall with a canopy cover ranging from 15 to 25 percent and an herbaceous understory of at least 15 percent grass canopy cover and 10 percent forb canopy cover that is at least 18 cm (7 in.) tall. Ideally, these vegetative conditions should be on 80 percent of the breeding habitat for any given population of sage-grouse.

Brood-rearing habitats. Early brood-rearing generally occurs relatively close to nest sites; however, movements of individual broods may be highly variable (Connelly 1982, Gates 1983). An optimum brood habitat, like that of breeding, consists of sagebrush stands that are 40 to 80 cm (16 to 32 in.) tall with a canopy cover of 10 to 25 percent and an herbaceous understory of 15 percent grass canopy and 10 percent forb canopy. For brood rearing, however, this type of habitat need only be found on at least 40 percent of the area. Hens with broods may use relatively open sagebrush habitats having less canopy cover (about 14 percent) than optimum nesting habitat (Martin 1970, Wallestad 1971), but need an understory canopy cover of at least 15 percent of grasses and forbs (Sveum et al. 1998). Chick diets include forbs and invertebrates (Drut et al. 1994). Insects, especially ants and beetles, are an important component of early brood-rearing habitat (Drut et al. 1994, Fischer et al. 1996a). Brood-rearing habitats having a wide diversity of plant species tend to provide an equivalent diversity of insects that are important chick foods. Hens with broods tend to select these types of areas.

In June and July, as sagebrush habitats dry and herbaceous plants mature, hens usually move their broods to more moist sites where more succulent vegetation is available (Connelly and Markham 1983, Connelly et al. 1988, Fischer et al. 1996b, Gates 1983, Gill 1965, Klebenow 1969, Savage 1969). Examples of such habitats include low sagebrush types (such as *A. nova* and *A. arbuscula*) and wet meadows (Connelly et al. 1988, Connelly and Markham 1983, Gates 1983, Martin 1970, Savage 1969). Where available, alfalfa fields and other farmlands or irrigated areas adjacent to sagebrush habitats are also used by sage-grouse. However, these habitat types are not uniformly distributed throughout the range of sage-grouse in Oregon. In addition, pesticides that are frequently applied on agricultural fields have negative impacts on sage-grouse survival (Bus et al. 1989).

Winter habitats. As fall progresses, sage-grouse move towards their winter ranges and shift their diet primarily to sagebrush leaves and buds (Connelly et al. 1988, Connelly and Markham 1983, Patterson 1952, Wallestad 1975). The exact timing of this movement varies, depending on the sage-grouse population, geographic area, overall weather conditions, and snow depth.

Sage-grouse winter habitats are relatively similar throughout most of their range. Because their winter diet consists almost exclusively of sagebrush, winter habitats must provide adequate amounts of sagebrush. Sagebrush canopy can be highly variable (Beck 1977, Eng and Schladweiler 1972, Patterson 1952, Robertson 1991, Wallestad et al. 1975). Sage-grouse tend to select areas with both high canopy and taller Wyoming big sagebrush (*A. t. wyomingensis*) and feed on plants highest in protein content (Remington and Braun 1985, Robertson 1991). It is critical that sagebrush be exposed at least 25 to 30 cm (10 to 12 in.) above snow level to provide food and cover for wintering sage-grouse (Hupp and Braun 1989). If snow covers the sagebrush, the birds move to areas where sagebrush is exposed. Therefore, good winter habitat consists of sagebrush with 10 to 30 percent canopy cover on 80 percent of the wintering area.

CURRENT SAGE-GROUSE SITUATION

Status of Sage-grouse

Historically, around 220 million acres of sagebrush-steppe vegetation types existed in North America (McArthur and Ott 1996), making it one of the most widespread habitats in the country. Much of this habitat, however, has been lost or degraded over the last 100 years. For example, in the interior Columbia River Basin, total acreage in sagebrush-steppe habitat has been reduced from about 40 million acres to 26 million acres, representing a loss of about 35 percent since the early 1900s (Hann et al. 1997) (Figure 1). Most remaining sagebrush-steppe ecosystems in Oregon are on public lands managed by BLM.

Sage-grouse have been extirpated in five states (Arizona, New Mexico, Oklahoma, Kansas, and Nebraska) and British Columbia and is “at risk” in six states (Washington, California, Utah, Colorado, North Dakota, and South Dakota) and in the Canadian provinces of Alberta and Saskatchewan. In five states (Oregon, Nevada, Idaho, Wyoming, and Montana), long-term population declines have averaged 30 percent since 1950.

Threats to the Species

As discussed below, numerous activities have adversely impacted, and continue to have potential to adversely impact, the distribution and quality of sage-grouse and their habitat. In addition, natural events and the human response to them could directly impact sage-grouse, as well as their habitat.

Agricultural conversion. Permanent conversion of sagebrush to agricultural lands is the single greatest cause of decline in sagebrush-steppe habitat in the interior Columbia Basin (Quigley and Arbelbide 1997). In the northern half of eastern Oregon, large areas of sagebrush-steppe habitat have been converted to agricultural lands (Wisdom et al. in press). Although sage-grouse do use some agricultural lands (such as alfalfa) for brood-rearing habitat, row crops are not beneficial habitat (Blus et al. 1989).

Rangeland conversion. Prior to the 1980s, herbicide treatment of large tracts of rangeland (primarily 2,4-D) was a common method of reducing sagebrush (Chart 1) (Braun 1987). In many cases, broad herbicide treatment may have contributed to declines in sage-grouse breeding populations (Enyeart 1956, Higby 1969, Peterson 1970, Wallestad 1975). A Utah study suggests that this adverse impact on sage-grouse was compounded in areas subsequently reseeded to crested wheatgrass (*Agropyron cristatum*) (Enyeart 1956).

Mechanical treatments (mowing, plowing, and chaining) of sagebrush have generally been more “local” in nature, but these, too, have adversely impacted sage-grouse habitat if done on a broad scale (Swensen et al. 1987). Even small-scale projects to reduce sagebrush can be damaging if in the wrong location, such as in winter habitat.

Livestock management. Various livestock management practices have altered sage-grouse habitat over the last century. Livestock facilities such as spring developments (Chart 2), water pipelines, and fencing (Chart 3) have distributed livestock use over areas formerly used only sporadically or lightly. In many areas, grazing has contributed to long-term changes in plant communities and reduced certain habitat components, such as biological crusts that contribute to the health of sagebrush-steppe habitat (Mack and Thompson 1982, Quigley and Arbelbide 1997, Wisdom et al. in press). Grazing too soon after disturbances such as fire may lead to long-term reductions in food plants and nesting cover. Current BLM policy provides for a minimum rest of two growing seasons following fire. Temporary, non-renewable use can result in removal of residual grass and the herbaceous plants needed for nesting cover. Past land treatments have included seedings (Chart 1), many of which did not include sagebrush, native forbs, and native grasses. This kind of seeding activity contributes to an increased dominance of exotic species that are detrimental to sage-grouse habitat.

Drought can lead to an increase in overlapping use among livestock, wild horses, and sage-grouse. Drought can exacer-

bate adverse effects of livestock and wild horse grazing on vegetation and soils (Vallentine 1990). In some instances, failure to timely adjust livestock use during drought has resulted in limited plant regrowth and overuse in wet meadows and riparian areas, negating gains in rangeland conditions during higher-precipitation years (Thurrow and Taylor 1999).

Grazing management is guided by land use plans and specific allotment management plans. In addition, grazing management practices will be applied to attain the Standards for Rangeland Health. Standard 5 specifically addresses protecting threatened and endangered and special status species. If it is determined that the rangeland health standards, including Standard 5, are not being met, appropriate changes in grazing management will be implemented prior to the next grazing year to ensure significant progress towards attainment of habitat objectives and the standards of rangeland health.

Wildfire and prescribed fire. Fire has altered sage-grouse habitat on the landscape in Oregon (Chart 4).

Sagebrush plants, especially Wyoming big sagebrush plants, are vulnerable to fire. Existing BLM fire management plans have not, for the most part, identified sage-grouse habitat as a high priority for protection. Furthermore, during multiple fire events, which are common in sagebrush- steppe habitat, prompt access to local BLM resource specialists knowledgeable about the location of critical sage-grouse habitat areas may be limited. Historical fire suppression tactics of “burning out” the unburned interior islands within fire perimeters has resulted in additional loss of habitat and loss of seed sources within the core area.

Repeated wildfires have favored invasion by cheatgrass (*Bromus tectorum*) and other exotic species (Pellant 1990, Valentine 1990). Conversion to cheatgrass alters the fire frequency from the historic 32- 70 years in sagebrush-steppe ecosystems to 5 years or less (Wright and others 1979). In this scenario, referred to by Pellant (1996) as the cheatgrass-wildfire cycle, the risk from wildfire is very high and fire suppression efforts are challenged by very high spread rates. This situation has increased the potential for large fires, carrying a threat for additional cheatgrass invasion onto adjacent areas not yet dominated by cheatgrass.

Prescribed fire has also contributed to the decrease in Wyoming big sagebrush habitat and sage-grouse brood-rearing habitat (Connelly et al. 1994, Fischer et al. 1996a). *The Federal Wildland Fire Management Policy and Program Review* (USDI and USDA 1995) indicates that, consistent with land and resource management plans, fire must be reintroduced into the ecosystem to restore and maintain ecosystem health and reduce wildfire risk. Recent budget increases in fuels management has resulted in the increased use of prescribed fire and other fuels management treatments.

Fire rehabilitation. The lack of prompt and appropriate fire rehabilitation following a wildfire can present additional threats to sage-grouse habitat. The seed supply of native species is generally limited during years of extreme fire when large acreages burn. Although the planting of brush species is more common now than in the past, sagebrush may not always be included in all rangeland fire rehabilitation seeding mixtures. Crested wheatgrass is often planted in lieu of native species or as a mixture with native species, because it is readily available and can successfully compete with cheatgrass. If cheatgrass or any of a number of other exotic plant species are present before a fire occurs, they are likely to become more dominant afterwards if the area is not properly rehabilitated.

Structures. Power lines, fences, roads, and urban development have all had an adverse impact on sage-grouse habitat and their populations (Braun 1998). Roads and associated human disturbances can have adverse impacts, especially to lek and winter habitat areas (Wisdom et al. in press). Power lines and fences provide perches for birds of prey and may actually cause direct mortality when sage-grouse fly into them (Connelly pers. comm.). Urban development results in direct loss due to fragmentation of habitat.

Juniper expansion. Before settlement by Euro-Americans, western juniper (*Juniperus occidentalis*) existed in open, savannah-like woodlands maintained by relatively frequent fires (Nichol 1937 in Miller and Rose 1995, West 1988 in Miller and Rose 1995) or were confined to rocky surfaces or ridges (Barney and Frishknecht 1974, Cottam and Stewart 1940, and Johnson and Simon 1987 in Miller and Rose 1995). These woodlands had an understory that included various sagebrush species. Since the 1880s, western juniper has expanded into mountain big sagebrush, low sage-

brush (*A. arbuscula*), quaking aspen (*Populus tremuloides*), and riparian communities (Miller and Rose 1995). The extent of the juniper-sagebrush cover type within the Columbia Basin more than doubled over the past century (Quigley and Arbelbide 1997). Increased livestock grazing in the late 1800s and early 1900s contributed to a reduction in fuels that could carry fire, thereby decreasing fire frequency (Eddleman and others 1994). In addition, fire suppression policies have generally lengthened fire-return intervals in juniper-dominated areas. Although restoring lands dominated by western juniper could benefit sage-grouse, certain types of post-treatment management could result in cheatgrass invasion, which would adversely impact native plant recovery. Also, while juniper may make poor habitat for sage-grouse and the reduction of juniper would be beneficial for them, we must be careful to adequately provide for the habitat needs of juniper-associated sensitive species such as the gray flycatcher (*Empidonax wrightii*).

Exotic invasive plants. Although cheatgrass proliferation has been widespread, increases in other exotic species such as medusahead (*Taeniatherum caput-medusae*), knapweed (*Centaurea spp.*) and yellow starthistle (*Centaurea solstitialis*) are also adversely impacting sagebrush-steppe habitat (Quigley and Arbelbide 1997). Many exotic plants are adapted to the Great Basin climate (Trewartha 1981 *in* Mack 1986, Young and others 1972 *in* Mack 1986). The rapid rate of expansion is partly attributable to the life history of exotic plants. Exotic plants are often opportunists, and many are pioneer, colonizing species. They are frequently one of the first species to arrive and colonize areas that have experienced soil-surface disturbance or areas that lack plant cover. Their establishment and spread are aided by disturbance to the soil surface (Baker 1986, Bazzaz 1986). Spotted knapweed (*C. maculosa*), yellow starthistle, and leafy spurge (*Euphorbia esula*), however, have exhibited the ability to invade relatively undisturbed sites, including wilderness areas (Asher 1994, Tyser and Key 1988).

Wild horses. Excessive grazing by wild horses has contributed to a decline in sage-grouse habitat over the last century. In some areas, grazing by wild horses has contributed to long-term changes in plant communities and reduced certain habitat components such as biological crusts, which contribute to the health of sagebrush-steppe habitat (Mack and Thompson 1982, Quigley and Arbelbide 1997, Wisdom et al. *in press*). Wild horses are managed by the BLM in 20 Herd Management Areas encompassing 2.8 million acres of public lands located primarily in southeastern Oregon. The cumulative Appropriate Management Level for horse numbers in these areas is 1,351 to 2,650 animals.

The management goals for wild horses are to manage them as components of the public lands and in a manner that preserves and maintains a thriving natural ecological balance in a multiple use relationship.

MANAGEMENT GOALS AND OBJECTIVES

The purpose of this BLM management strategy is to effectively promote conservation of sage-grouse and their habitats on BLM-administered public lands in Oregon and Washington.

Small, scattered tracts, such as those managed by BLM in Washington State, may require special consideration. In some cases with scattered tracts, BLM management activities may be inconsequential; in other instances, they may be critical.

Conservation Goals by Habitat

Leks: (Used by sage-grouse in March-April)

Sage-grouse breeding occurs on sites called leks. Generally, the sites are traditional (that is, the same lek sites are used year after year). Leks are established in open areas surrounded by sagebrush, which is needed for escape and protection from predators (Gill 1965, Patterson 1952). Examples of lek sites include old lake beds or playas; low sagebrush flats; openings on ridges; roads; landing strips; crop land; and burned areas (Connelly et al. 1981, Gates 1985).

Goal: Protect existing leks and provide secure sage-grouse breeding habitat with minimal disturbance and harassment.

Nesting and Early Brood-rearing: (Occurs April-June)

Optimum sage-grouse nesting habitat consists of a healthy sagebrush ecosystem complete with sagebrush plants and an herbaceous understory composed of grasses and forbs. Nesting and early brood-rearing periods are critical time periods for sage-grouse and their biological requirements.

Goal: Promote habitat that supports nesting and early brood-rearing success, including maintenance or recovery of the following.

- Shrub and herbaceous (native grasses and forbs) cover, including residual cover adequate to conceal sage-grouse nests and broods from predation.
- Plant communities that provide a diversity of plant and insect food sources.

Late Brood-rearing: (Occurs June-October)

Sage-grouse broods use a variety of habitats from summer through fall. Generally, these habitats are characterized by relatively moist conditions and many succulent forbs in or adjacent to sagebrush cover. These habitats include sagebrush, meadows and riparian areas, dry lake beds, and agricultural lands.

Goal: Promote habitat conditions that support growth and survival of young sage-grouse in late brood-rearing habitat.

Wintering: (Occurs November-February)

Winter diet is primarily sagebrush leaves and buds. Sagebrush canopy cover used by sage-grouse in the winter can be highly variable (Beck 1977, Eng and Schladweiler 1972, Patterson 1952, Robertson 1991, Wallestad et al. 1975). It is critical that sagebrush be exposed at least 25 to 30 cm (10 to 12 in.) above snow level to provide food and cover to wintering birds.

Goal: Maintain sagebrush that is accessible to sage-grouse for food and cover during the winter months.

Objectives

The following objectives are intended as guidance until a long-term conservation management plan is developed and implemented. The objectives are applicable to sagebrush habitats on public lands managed by BLM in Oregon and Washington. These objectives, as well as the guidelines derived from them, are not intended to supersede existing land use plans or compliance with the *National Environmental Policy Act* or any other applicable laws or regulations.

The objectives are:

1. Identify and map historical, current, and potential sage-grouse habitats.
2. Using these management guidelines, maintain and enhance existing sage-grouse habitats, particularly areas of high ecological integrity.
3. Using these management guidelines, permit no net loss of sage-grouse habitat as a result of new actions authorized by BLM; minimize habitat losses resulting from natural disturbances (wildland fire, insects, disease, etc.).
4. Provide sage-grouse habitats secure from direct human disturbance during the winter and breeding seasons, which are critical times when birds are concentrated and susceptible to harassment.
5. Ensure that actions authorized on BLM-administered lands do not contribute to the need to list sage-grouse under the provisions of the *Endangered Species Act*.

SAGE-GROUSE AND SAGEBRUSH-STEPPE MANAGEMENT GUIDELINES

This management strategy is to be implemented in concert with the process established in BLM's "*Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands in Oregon and Washington*" (S&Gs) and other applicable laws, regulations, and policies. The strategy represents interpretation of the Oregon/Washington BLM's S&Gs as they apply to managing uses affecting sage-grouse habitats and sagebrush ecosystems.

Throughout this document, the terms "*known/occupied habitat*" and "*habitat*" are used. "*Known/occupied habitats*" are those habitats known to be currently occupied and used by sage-grouse for breeding, nesting, brood-rearing, or wintering. "*Habitat*" refers to the kinds of land, land forms, and plant communities that may support, or historically supported, sage-grouse during breeding, nesting, brood-rearing, or wintering. Although these habitats may be vitally important to sage-grouse, there is a lack of information about sage-grouse occupancy. Until more information is developed, BLM will treat sagebrush habitats as potential habitat.

These are guidelines and, as such, deviation from these guidelines is appropriate, based on professional judgement and concurrence of the Field Manager. For example, the management guidelines (such as size of buffers, time frames, etc.) may be modified if monitoring indicates that current sage-grouse use patterns are not consistent with use patterns described in the guidelines. There may also be instances where changes are needed to protect other resources or accommodate other uses. These deviations and their rationale must be documented.

The best available data on known sage-grouse lek, nesting, brood-rearing, and winter habitats are available on maps and administrative records in each respective BLM District Office.

Management Actions

Sage-grouse habitats				
Management Actions	Leks	Nesting/Early Brood Rearing	Late Brood Rearing	Wintering
Grazing				
<ul style="list-style-type: none"> Where livestock grazing results in a level of forage use (utilization level) consistent with Resource Management Plans, Allotment Management Plans, Terms and Conditions of Grazing Permits or Leases, other allotment specific direction, and regulations, no changes to use or management are required if habitat quality is determined to meet guidelines within the capability of the site (Connelly et al. in press). Livestock allocations should only be increased if it can be demonstrated that there are no detrimental effects on sage-grouse habitat quality. 	X	X	X	X
<ul style="list-style-type: none"> Where livestock grazing results in a level of forage use (utilization levels) determined to have detrimental effects to habitat quality, changes in grazing management that will improve or restore habitat quality will be made as soon as practical but no later than the start of the next grazing year pursuant to 43 CFR 4180.2(c). Examples of changes in management that should be considered include: temporary livestock exclusion (rest); permanent livestock exclusion; change in the season, duration, or intensity of use; fencing; and changes in salting and/or watering locations. 	X	X		
<ul style="list-style-type: none"> Where wild horse grazing detrimentally effects sage-grouse habitat quality, wild horse numbers should be reduced to appropriate management levels. 	X	X	X	X
<ul style="list-style-type: none"> Provide secure sage-grouse breeding ground habitat to reduce physical disturbance to sage-grouse by managing locations of salt or mineral supplements within 0.4 km (1/4 mi) of lek locations. 	X			
<ul style="list-style-type: none"> Timing and location of livestock turnout and trailing should not contribute to livestock concentrations on leks during the sage-grouse breeding season. 	X			
<ul style="list-style-type: none"> Grazing use levels within known/occupied habitat will be determined specifically for those habitats, not averaged with use levels for the remainder of the pasture or grazing units. 		X	X	X
<ul style="list-style-type: none"> Avoid supplemental winter feeding of livestock in known/occupied habitat. 		X		X

Management Actions

Sage-grouse habitats				
Management Actions	Leks	Nesting/Early Brood Rearing	Late Brood Rearing	Wintering
Realty				
<ul style="list-style-type: none"> Use existing utility corridors and rights-of-way to consolidate activities to reduce habitat loss, degradation, and fragmentation of new construction, except where topographic features or other barriers reduce impacts associated with avian predation. Wherever possible and practicable, install new power lines within existing power line corridors. 	X	X	X	X
<ul style="list-style-type: none"> Examine proposed land exchanges for impacts on sage-grouse. If possible, use land exchanges to block up important sage-grouse habitat. 	X	X	X	X
Structures				
<ul style="list-style-type: none"> Construct new spring developments to maintain their free-flowing nature and wet meadow characteristics. Where priority and funding permits, retrofit existing springs to restore free-flowing nature. 	X	X	X	X
<ul style="list-style-type: none"> Install wildlife escape ramps in all new water troughs. Where priority and funding permits, retrofit existing water troughs. 	X	X	X	X
<ul style="list-style-type: none"> Construct new livestock facilities (livestock troughs, fences, corrals, handling facilities, "dusting bags," etc.) at least 1 km (0.6 mi.) from leks to avoid concentration of livestock, collision hazards to flying birds, or avian predator hunting perches. 	X			
<ul style="list-style-type: none"> Construct new facilities (kiosks, toilets, signs, etc.) at least 1 km (0.6 mi.) from leks to minimize disturbance during the breeding season. 	X			
<ul style="list-style-type: none"> New livestock water developments should be built outside known/occupied sage-grouse nesting habitat unless it can be shown that the development will not adversely affect the habitat. 		X		
<ul style="list-style-type: none"> Construct new facilities (kiosks, toilets, signs, etc.) to minimize disturbance in known/occupied sage-grouse nesting and early brood-rearing habitat. Avoid construction of facilities that provide avian predator perches unless they include mitigating features such as perch guards. 		X		
Energy and Minerals (leasable, salable, and locatable (where a plan of operations is required))				
<ul style="list-style-type: none"> Avoid surface occupancy within 1 km (0.6 mi.) of known/occupied sage-grouse habitat. 	X	X	X	X

Management Actions

Sage-grouse habitats				
Management Actions	Leks	Nesting/Early Brood Rearing	Late Brood Rearing	Wintering
Vegetation Treatment				
<ul style="list-style-type: none"> Vegetation manipulations should benefit the long-term health of sage-grouse habitat. 	X	X	X	X
<ul style="list-style-type: none"> Aggressively treat noxious weeds and other invasive plants where they threaten quality of sage- grouse habitat. 	X	X	X	X
<ul style="list-style-type: none"> Use mechanical treatment or prescribed fire to remove juniper where it has invaded into riparian areas and sites with mountain big sagebrush or low sagebrush. The intent is to reduce juniper <i>before</i> the increasing juniper density begins to reduce species diversity within these sagebrush types. 	X	X	X	X
<ul style="list-style-type: none"> Avoid vegetation treatments in sage-grouse habitat in areas that are highly susceptible to invasion by cheatgrass or other exotic species. Any vegetation treatments conducted in cheatgrass-dominated communities will be accompanied by restoration and, if necessary, reseeding to achieve reestablishment of native vegetation. 	X	X	X	X
<ul style="list-style-type: none"> In known or potential habitat, use vegetation treatments that are expected to result in quality sage- grouse habitat. Ensure vegetation treatments (including fire rehabilitation, new seedings, and seeding renovations) are appropriate to the soil, climate, and land form of the area. 	X	X	X	X
<ul style="list-style-type: none"> Rangeland seedings should include a variety of native grasses, forbs, and sagebrush that will recover the ecological processes and habitat features of the potential natural vegetation. 	X	X	X	X
<ul style="list-style-type: none"> Avoid prescribed fire in Wyoming big sagebrush and lower-elevation basin big sagebrush unless such treatments are highly likely to improve sage-grouse habitat. Use Attachment I, Guidelines for Management of Sage-grouse Populations and Habitats (Connelly et al. 2000), as a resource for planning prescribed fire in late brood-rearing habitat. 			X	X
<ul style="list-style-type: none"> Use brush beating (or other appropriate treatment) in areas with relatively high shrub cover (greater than 30%) to improve late brood-rearing habitat (see Attachment I for guidelines). 			X	

Management Actions

Sage-grouse habitats				
Management Actions	Leks	Nesting/Early Brood Rearing	Late Brood Rearing	Wintering
Fire Management				
<ul style="list-style-type: none"> Fire specialists and wildlife biologists should annually review District Fire Management Plans (Phase I) to incorporate new sage-grouse information in setting wildfire suppression priorities in sage-grouse habitat. Distribute updates to Phase I Fire Plans to dispatchers for initial attack planning and dispatching. Annually review new sage-grouse information with fire specialists. 	X	X	X	X
<ul style="list-style-type: none"> Train and use resource advisors to assist with prioritizing rangeland fires during multiple ignition episodes and to work with Incident Commanders as appropriate. 	X	X	X	X
<p>Minimize the amount of sage-grouse habitat burned by the following actions:</p> <ul style="list-style-type: none"> Give wildfire suppression priority to known sage-grouse habitat within the framework of the Federal Wildland Fire Policy (human life and safety as the first priority, with property and natural resources as second priorities, USDI and USDA 1995). 	X	X	X	X
<ul style="list-style-type: none"> Use direct attack tactics when it is safe and effective at reducing amount of burned habitat. 	X	X	X	X
<ul style="list-style-type: none"> Retain unburned areas (including interior islands and patches between roads and the fire perimeter) of sage-grouse habitat unless there are compelling safety, resource protection, or control objectives at risk. 	X	X	X	X
<ul style="list-style-type: none"> The habitat character of the lek and surrounding sagebrush cover within 300 meters (985 ft.), as well as identified winter range, should be given top priority in fire suppression. Ground- disturbing fire suppression actions, such as the use of heavy equipment and excessive brush removal, should be judiciously applied to protect sage-grouse habitat. 	X			X

Management Actions

Sage-grouse habitats				
Management Actions	Leks	Nesting/Early Brood Rearing	Late Brood Rearing	Wintering
Fire Rehabilitation				
<ul style="list-style-type: none"> Evaluate all wildfires burning more than 100 acres of sage-grouse habitat to determine if seeding is necessary to recover ecological processes and achieve habitat objectives. If seeding is necessary, use appropriate mixtures of sagebrush, native grasses, forbs, and appropriate nonnative perennials that will increase the probability of recovering ecological processes and habitat features of the site. Potential benefits to sage-grouse populations should be considered in prioritizing sites for restoration. For fires occurring in Wyoming big sagebrush, sites will be re-seeded with Wyoming big sagebrush when available. 	X	X	X	X
<ul style="list-style-type: none"> All areas where wildfires burn more than 10 acres in sites known to be prone to invasion by cheatgrass or other exotic plants will be seeded with an appropriate seed mixture to reduce the probability of cheatgrass establishment on that site. Potential benefits to sage-grouse populations should be considered in prioritizing sites for seeding. 	X	X	X	X
Recreation				
<ul style="list-style-type: none"> Initiate emergency seasonal or area closures, as needed, to protect key habitat of sage-grouse. 	X	X	X	X

IMPLEMENTATION MONITORING

Critical to BLM's success in properly managing sagebrush-steppe ecosystems is the ability to track outcome measures that reflect how well guidelines are being implemented. Districts shall provide an annual report at the end of each fiscal year, beginning in FY2001. The report will include the following:

Baseline Information

- Total district acreage (# acres)
- Known/occupied sage-grouse habitat (# acres)
- Acres assessed for Rangeland Health (# acres)
- Acres meeting Standard 5 (# acres)

Leks - (using ODFW and WDFW) data)

- Total number of leks (#)
- Number of leks surveyed (#)
- Sage-grouse population estimate (#)

Grazing

- Number of allotments with known/occupied sage-grouse habitats (#)
- Number of allotments assessed for Rangeland Health (#)
 - Number of allotments not meeting Standard 5 - livestock caused (#)
 - Number of allotments not meeting Standard 5 - other causes (#)
- Corrective actions taken (narrative)

Recreational Use

- Road or area closures required in known/occupied sage-grouse habitat
 - Number
 - Acres
- Total mileage of new roads in known/occupied sage-grouse habitat (mi)

Lands and Realty

- Total number and acres of land exchanges during Fiscal Year (# acres)
- Land exchanges requiring sage-grouse consideration (#, narrative)
- Rights-of-way authorized in known sage-grouse habitat (#)
- Rights-of way evaluated under sage-grouse guidelines (#)
- Restrictions applied to rights-of-ways due to guidelines (description)

Energy and Minerals

- Actions taken relative to energy/minerals programs to protect sage-grouse habitat
 - Number
 - Description

Structures

- New structures (fences, power lines, etc.) within sage-grouse habitat
 - Kind/number
 - Application of management guidelines (description)
- Total number of new water developments within sage-grouse habitat (#)
- Installation of escape ramps in new livestock troughs (#)
- Livestock troughs retrofitted with escape ramps (#)

Wildland Fire

- District fire management plan updated to include sage-grouse information (yes/no)
- Known/occupied sage-grouse habitat burned in wildfire (# acres)
- Acres seeded to grass/forb/shrub mixture following wildfires (# acres)

Vegetation Treatment

Vegetation Treatments				
	Prescribed burning (acres)	Mechanical treatment (acres)	Weed Control (acres)	Weed Control (type ¹)
Total Acres Treated				
Treatments In:				
Wyoming big sagebrush				
Mountain big sagebrush				
Known sage-grouse habitat				
Acres seeded in native grass/forb/shrub mixture				
¹ Chemical, mechanical, biological				

LITERATURE CITED

- Asher, J. 1994. Crushing the wilderness spirit: Alien plant invasions. Unpublished report on file with: U.S. Department of the Interior, Bureau of Land Management, Oregon State Office, P.O. Box 2965, Portland, Oregon 97201.
- Autenrieth, R. E. 1981. Sage grouse management in Idaho Wildlife Bulletin Number 9. Idaho Department of Fish and Game. Boise. 239 p.
- Baker, H.G. 1986. Patterns of plant invasion in North America. Pages 44-57 in: Mooney, H.A. and J.A. Drake, editors, Ecology of biological invasions of North America and Hawaii. Springer-Verlag, New York.
- Barnett, J. E., and J. A. Crawford. 1994. Pre-laying nutrition of sage grouse hens in Oregon. Journal of Range Management 47:114-118.
- Barney, M.A.; Frischknecht, N.C. 1974. Vegetation changes following fire in the pinyon-juniper type of west-central Utah. J. of Range Management 27:91-96.
- Bazzaz, F.A. 1986. Life history of colonizing plants: Some demographic, genetic, and physiological features. Pages 96-110 in: Mooney, H.A. and J.A. Drake, editors, Ecology of biological invasions of North America and Hawaii. Springer-Verlag, New York.
- Beck, T. D. I. 1977. Sage grouse flock characteristics and habitat selection during winter. Journal of Wildlife Management 41:18-26.
- Beck, T. D. I. 1975. Attributes of a wintering population of sage grouse, North Park, Colorado. M.S. thesis. Colorado State University, Fort Collins. 49 p.
- Bergerud, A. T. 1988. "Population ecology of North American grouse." Pages 578-648 in A.T. Bergerud and M. W. Gratson, eds. *Adaptive strategies and population ecology of northern grouse*. University of Minnesota Press, Minneapolis. 809 p.
- Berry, J. D., and R. L. Eng. 1985. Interseasonal movements and fidelity to seasonal use areas by female sage grouse. Journal of Wildlife Management 49:237-240.
- Blaisdell, James P., Robert B. Murray, Durant E. McArthur 1982. Managing Intermountain rangelands - sagebrush-grass ranges. General Technical Report. INT-134. Ogden, UT: U. S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 41 p.
- Blus, L. J., C. S. Staley, C. J. Henny, G. W. Pendleton, T. H. Craig, E. H. Craig, and D. K. Halford. 1989. Effects of organophosphorus insecticides on sage grouse in southeastern Idaho. Journal of Wildlife Management 53:1139-1146.
- Braun, C. E. 1987. Current issues in sage grouse management. Proceedings of the Western Association of Fish and Wildlife Agencies 67:134-144.
- Braun, C. E. 1998. Sage grouse declines in western North America: what are the problems? Proceedings of the Western Association of State Fish and Wildlife Agencies. 78:139-156.
- Braun C. E., T. Britt, and R. O. Wallestad. 1977. Guidelines for maintenance of sage grouse habitats. Wildlife Society Bulletin 5:99-106.
- Coggins, K. A. 1998. Sage grouse habitat use during the breeding season on Hart Mountain National Antelope Refuge. M.S. thesis, Oregon State University, Corvallis. 61 p.
- Connelly, J. W., Jr. 1982. An ecological study of sage grouse in southeastern Idaho. Ph.D. dissertation, Washington State University, Pullman. 84 p.
- Connelly, J. W., and C. E. Braun. 1997. Long-term changes in sage grouse *Centrocerus urophasianus* populations in western North America. Wildlife Biology 3:123-128.
- Connelly, J. W., and O. D. Markham. 1983. Movements and radio nuclide concentrations of sage grouse in southeastern Idaho. Journal of Wildlife Management 47:169-177.
- Connelly, J. W., W. J. Arthur, and O. D. Markham. 1981. Sage grouse leks on recently disturbed sites. Journal of Range Management 52:153-154.
- Connelly, J. W., H. W. Browsers, and R. J. Gates. 1988. Seasonal movements of sage grouse in southeastern Idaho. Journal of Wildlife Management 52:116-122.

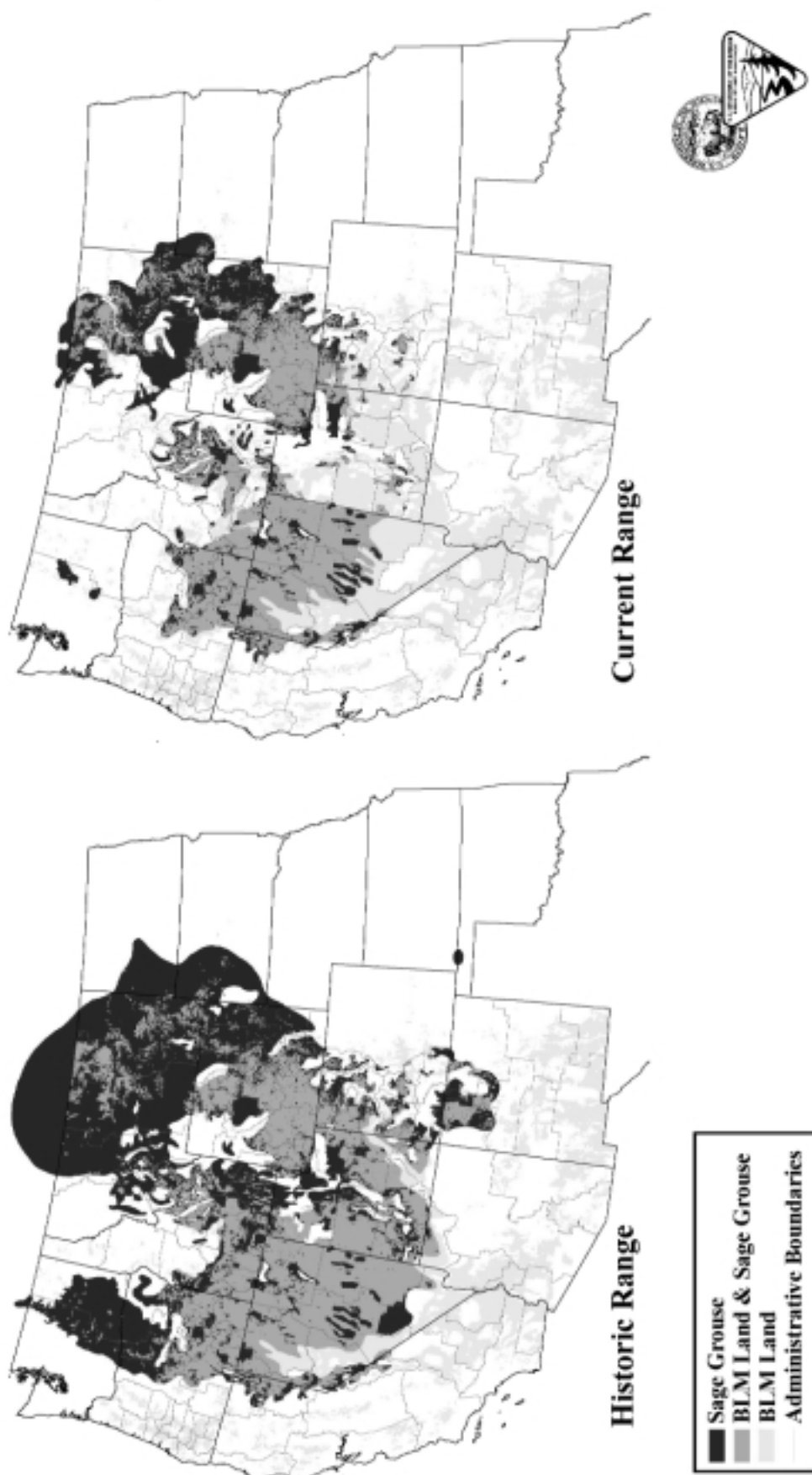
- Connelly, J. W., W. L. Wakkinen, A. D. Apa, and K. P. Reese. 1991. Sage grouse use of nest sites in southeastern Idaho. *Journal of Wildlife Management* 55:521-524.
- Connelly, J. W., R. A. Fischer, A. D. Apa, K. P. Reese, and W. L. Wakkinen. 1993. Renesting of sage grouse in southeastern Idaho. *Condor* 95:1041-1043.
- Connelly, J. W., K. P. Reese, W. L. Wakkinen, M. D. Robertson, and R. A. Fischer. 1994. Sage grouse ecology report. Idaho Department of Fish and Game Job Completion Report. W-160-R-19. Subproject 9. 91 p.
- Connelly, J. W., M. A. Schroeder, A. R. Sands, C. E. Braun. Guidelines for management of sage grouse populations and habitats. *Wildlife Society Bulletin* in press.
- Crawford, J. A. and R. S. Lutz. 1985. Sage grouse populations in Oregon, 1941-1983. *Murrelet* 66:69-74.
- Cottam, W. P. and G. Stewart. 1940. Plant succession as a result of grazing and of meadow desiccation by erosion since settlement in 1892. *J. Forestry* 38: 613-626.
- Dalke, P. D., D. B. Pyrah, D. C. Stanton, J. E. Crawford, and E.F. Schlatterer. 1963. Ecology, productivity, and management of sage grouse in Idaho. *Journal of Wildlife Management* 27:810-841.
- DeLong, A. K., J. A. Crawford, and D. C. DeLong, Jr. 1995. Relationships between vegetational structure and predation of artificial sage grouse nests. *Journal of Wildlife Management* 59:88-92.
- Drut, M. S., W. H. Pyle, and J. A. Crawford. 1994. Diets and food selection of sage grouse chicks in Oregon. *Journal of Range Management* 47:90-93.
- Edelmann, F. B., M. J. Ulliman, M. J. Wisdom, K. P. Reese, and J. W. Connelly. 1998. Assessing habitat quality using population fitness parameters: a remote sensing/GIS-based habitat-explicit population model for sage grouse . . . (*Centrocercus urophasianus*). Technical Report 25. Idaho Forest, Wildlife and Range Experiment Station, Moscow. 33 p.
- Edminster, F. C. 1954. American game birds of field and forest. Charles Scribner's Sons, NY. 490pp.
- Eng, R. L. 1963. Observations on the breeding biology of male sage grouse. *Journal of Wildlife Management* 27:841-846.
- Eng, R. L., and P. Schladweiler. 1972. Sage grouse winter movements and habitat use in central Montana. *Journal of Wildlife Management* 36:141-146.
- Enyeart, G. 1956. Responses of sage grouse to grass reseeding in the Pines area, Garfield County, Utah. M.S. thesis, Utah State Agricultural College, Logan. 55 p.
- Fischer, R. A. 1994. The effects of prescribed fire on the ecology of migratory sage grouse in southeastern Idaho.
- Fischer, R. A., K. P. Reese, and J. W. Connelly. 1996a. An investigation on fire effects within xeric sage grouse brood habitat. *Journal of Range Management* 49:194-198.
- Fischer, R. A., K. P. Reese, and J. W. Connelly. 1996b. Influence of vegetal moisture content and nest fate on timing of female sage grouse migration. *Condor* 98:868-872.
- Gates, R. J. 1983. Sage grouse, lagomorph, and pronghorn use of a sagebrush grassland burn site on the Idaho National Engineering Laboratory. M. S. thesis, Montana State University, Bozeman. 135pp.
- Gates, R. J. 1985. Observations of the formation of a sage grouse lek. *Wilson Bulletin* 97:219-221.
- Gill, R. B. 1965. Distribution and abundance of a population of sage grouse in North Park, Colorado. M. S. thesis, Colorado State University, Fort Collins. 187 p.
- Gray, G. M. 1967. An ecological study of sage grouse broods with reference to nesting movements, food habits and sage brush strip spraying in the Medicine Lodge drainage, Clark County, Idaho. M.S. thesis, University of Idaho, Moscow. 200 p.
- Gregg, M. A. 1991. Use and selection of nesting habitat by sage grouse in Oregon. M.S. thesis, Oregon State University Corvallis. 46 p.
- Gregg, M. A., J. A. Crawford, M. S. Drut, and A. K. DeLong. 1994. Vegetational cover and predation of sage grouse nests in Oregon. *Journal of Wildlife Management* 58:162-166.
- Hanf, J. M., P. A. Schmidt, and E. B. Groshens. 1994. Sage grouse in the high desert of central Oregon: results of a study, 1988-1993. U. S. Department of Interior, Bureau of Land Management Series P-SG-01, Prineville, OR. 56 p.

- Hann, W. J., J. L. Jones, M. G. Karl, P. F. Hessburg, R. E. Kean, D. G. Long, J. P. Menakis, C. H. McNicoll, S. G. Leonard, R. A. Gravenmier, and B. G. Smith. 1997. An assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great Basins, Vol. II. Landscape dynamics of the basin. U.S. Dept. Agric., Pacific Northwest Res. Stat., For. Serv. Gen. Tech. Rep. PNW-GTR-405, Portland, OR.
- Higby, L. W. 1969. A summary of the Longs Creek sagebrush control project. Proceedings Biennial Western States Sage Grouse Workshop. 6:164-168.
- Hironaka, M., M. A. Fosberg, A. H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Bull 35. Univ. Idaho, Forest, Wildl. and Range Exp. Stn. Moscow, ID. 44 p.
- Holechek, J. L., H. Gomez, F. Molinar, and D. Galt. 1999. Grazing studies: What we've learned. Rangelands. Vol. 21, (2), pp. 12-16.
- Hupp, J. W. and C. E. Braun. 1989. Topographic distribution of sage grouse foraging in winter. Journal of Wildlife Management 53:823-829.
- Interagency Technical Reference. 1996. Utilization studies and residual measurements. Cooperative Extension Service, Bureau of Land Management, U. S. Forest Service, and Natural Resource Conservation Service. 176 p.
- Klebenow, D. A. 1969. Sage grouse nesting and brood habitat in Idaho. Journal of Wildlife Management 33:649-661.
- Mack, R.N. 1986. Alien plant invasion into the Intermountain West: A case history. Pages 191-213 in: Mooney, H.A. and J.A. Drake, editors, Ecology of biological invasions of North America and Hawaii. Springer-Verlag, New York.
- Mack, R. N. and J. N. Thompson 1982. Evolution in steppe with few large, hoofed mammals. American Naturalist 119:757-773.
- Martin, N. S. 1970. Sagebrush control related to habitat and sage grouse occurrence. Journal of Wildlife Management 34:313-320.
- McArthur, E. D. and J. E. Ott. 1996. Potential natural vegetation in the 17 conterminous western United States. pp. 16-28 // Proceedings: Shrub land ecosystem dynamics in a changing environment, J. R. Barrow, E. D. McArthur, R. E. Sosebee and R. J. Tausch, compilers. USDA Forest Service Gen. Tech. Rep. INT-GTR-338. Ogden, UT.
- Miller, R.E., and J.A. Rose. 1995. Historic expansion of *Juniperus occidentalis* (western juniper) in southeastern Oregon. Great Basin Naturalist 55:37-45.
- Patterson, R. L. 1952. The sage grouse in Wyoming. Sage Books, Inc. Denver, CO. 341 p.
- Pellant, M. 1996. Use of indicators to qualitatively assess rangeland health. *Rangelands in a Sustainable Biosphere*. (Ed. N.E. West), pp434-435. Proc. Vth International Rangeland Congress. Society for Range Management. Denver, CO.
- Pellant, Mike. 1990. The cheatgrass-wildfire cycle—are there any solutions? In: McArthur, E. Durant; Romney, Evan M.; Smith, Stanley D; Tueller, Paul T., comps. Proceedings —symposium on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management: 1989 April 5-7; Las Vegas, NV. Gen. Tech. Rep. INT-276. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 11-17
- Petersen, B. E. 1980. Breeding and nesting ecology of female sage grouse in North Park, Colorado. M.S. thesis, Colorado State University, Fort Collins, CO. 86 p.
- Peterson, J. G. 1970. The food habits and summer distribution of juvenile sage grouse in central Montana. Journal of Wildlife Management 34:147-155.
- Quigley, T.M., and S.J. Arbelbide, technical editors. 1997. Volume II of: An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great Basins. General Technical Report PNW-GTR-405. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.
- Remington, T. E., and C. E. Braun. 1985. Sage grouse food selection in winter, North Park, Colorado. Journal of Wildlife Management 49:1055-1061.
- Robertson, M. D. 1991. Winter ecology of migratory sage grouse and associated effects of prescribed fire in southeastern Idaho. M.S. thesis, University of Idaho, Moscow, ID. 88 p.
- Savage, D. E. 1969. Relation of sage grouse to upland meadows in Nevada. Nevada Fish and Game Commission Job Completion Report, Project W-39-R-9. Job 12. Reno. 101 p.
- Schroeder, M. A. 1997. Unusually high reproductive effort by sage grouse in a fragmented habitat in north-central Washington. Condor 99:933-941.

- Schroeder, M. A., J. R. Young and C. E. Braun. 1999. Sage Grouse (*Centrocercus urophasianus*). In The Birds of North America, No. 425 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Sheppard, C. 1995. The shifting baseline syndrome. Marine Pollution Bulletin. 30:766-767.
- Sveum, C. M., J. A. Crawford, and W. D. Edge. 1998. Use and selection of brood-rearing habitat by sage grouse in south central Washington. Great Basin Naturalist 58:344-351.
- Swenson, J. E., C. A. Simmons, and C. D. Eustace. 1987. Decrease of sage grouse *Centrocercus urophasianus* after ploughing of sagebrush steppe. Biological Conservation 41:125-132.
- Swenson, J. E. 1986. Differential survival by sex in juvenile sage grouse and gray partridge. Ornis Scandinavica 17:14-17.
- Thurrow, T. L., and C. A. Taylor. 1999. The role of drought in range management. Journal of Range Management 52:413-419.
- Trueblood, R. W. 1954. The effect of grass reseeding in sagebrush lands on sage grouse populations. M.S. thesis, Utah State Agricultural College, Logan, UT.
- Tyser, R.W., and C.H. Key. 1988. Spotted knapweed in natural area fescue grasslands: An ecological assessment. Northwest Science 62:151-160.
- USDI and USDA 1995. Federal wildland fire management policy and program review. 45 p.
- Valentine, J. E. 1990. Grazing management. Academic Press, Incorporated. San Diego, CA. 553pp.
- Vavra, M., W.A. Laycock, and R. D. Pieper. 1994. Ecological implications of livestock herbivory in the west. Society for Range Management. Denver, CO. 297 p.
- Wakkinen, W. L. 1990. Nest site characteristics and spring-summer movements of migratory sage grouse in southeastern Idaho. M. S. thesis, University of Idaho, Moscow. 57 p.
- Wakkinen, W. L., K. P. Reese, and J. W. Connelly. 1992. Sage grouse nest locations in relation to leks. Journal of Wildlife Management 56:381-383.
- Wallestad, R. O. 1971. Summer movements and habitat use by sage grouse broods in central Montana. Journal of Wildlife Management 35:129-136.
- Wallestad, R. O. 1975. Life history and habitat requirements of sage grouse in central Montana. Montana Fish and Game Department Technical Bulletin. 66 p.
- Wallestad, R. O., and D. B. Pyrah. 1974. Movement and nesting of sage grouse hens in central Montana. Journal of Wildlife Management 38:630-633.
- Wallestad, R. O., and P. Schladweiler. 1974. Breeding season movements and habitat selection of male sage grouse. Journal of Wildlife Management 38:634-637.
- Wallestad, R. O., J. G. Peterson, and R. L. Eng. 1975. Foods of adult sage grouse in central Montana. Journal of Wildlife Management 39:628-630.
- Wisdom, M.J., R.S. Holthausen, B.C. Wales, D.C. Lee, C.D. Hargis, V.A. Saab, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, and M.R. Eames. [in press]. Source habitats for terrestrial vertebrates of focus in the interior Columbia Basin: Broad-scale trends and management implications. General Technical Report PNW-GTR-XXX. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.
- Wright, H.A., L.F. Neuenschwander, and C.M. Britton. 1979. The role and use of fire in sagebrush-grass and pinyon-juniper plant communities: A state-of-the-art review. General Technical Report INT-GTR-58. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT.
- Zablan, M. A. 1993. Evaluation of sage grouse banding program in North Park, Colorado. M.S. thesis, Colorado State University, Fort Collins, CO. 59 p.

MAP 1

SAGE GROUSE DISTRIBUTION



MAP 2

General Greater Sage - Grouse Distribution in Oregon and Washington

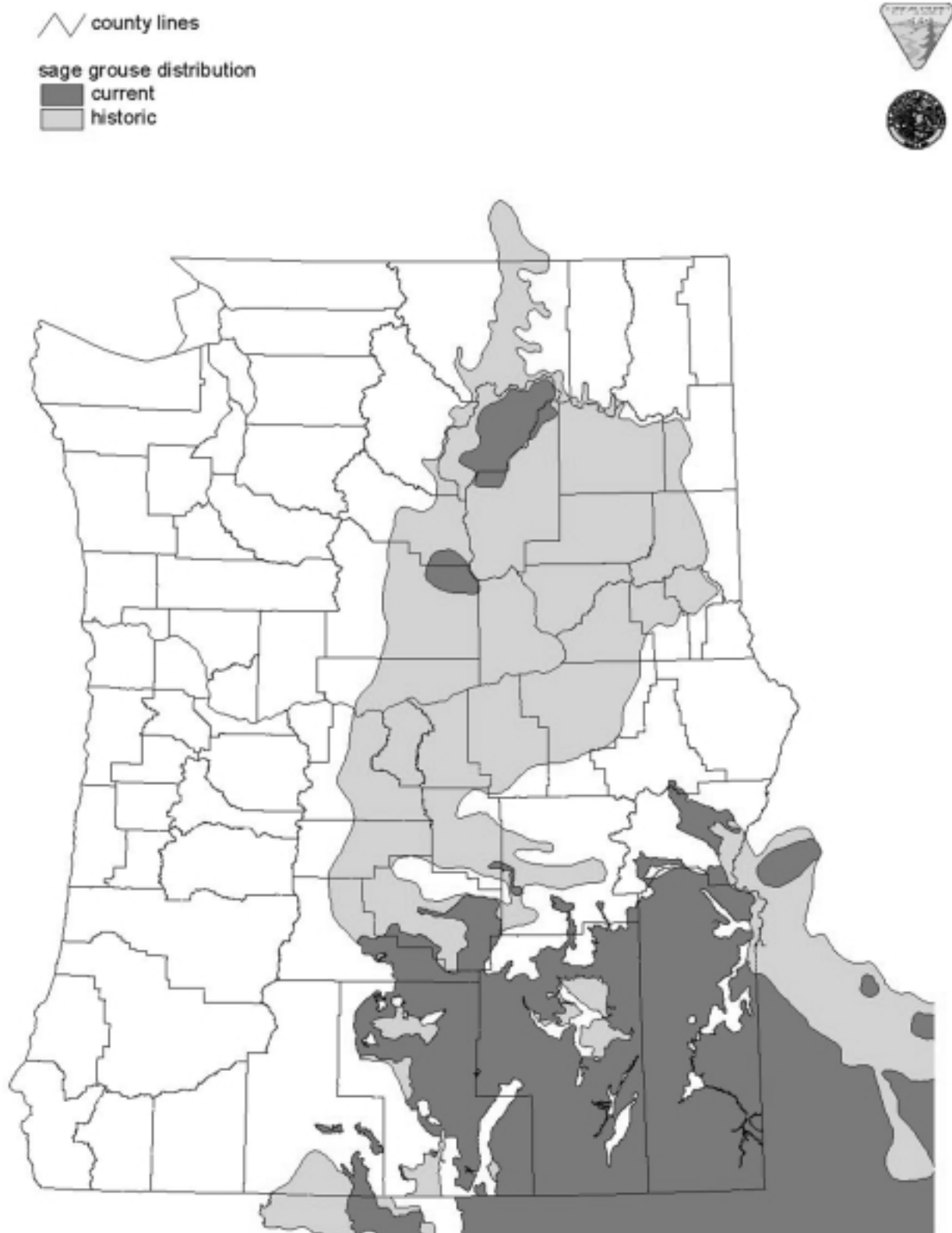


Chart 1
Brush Control and Seedlings
Oregon BLM Lands

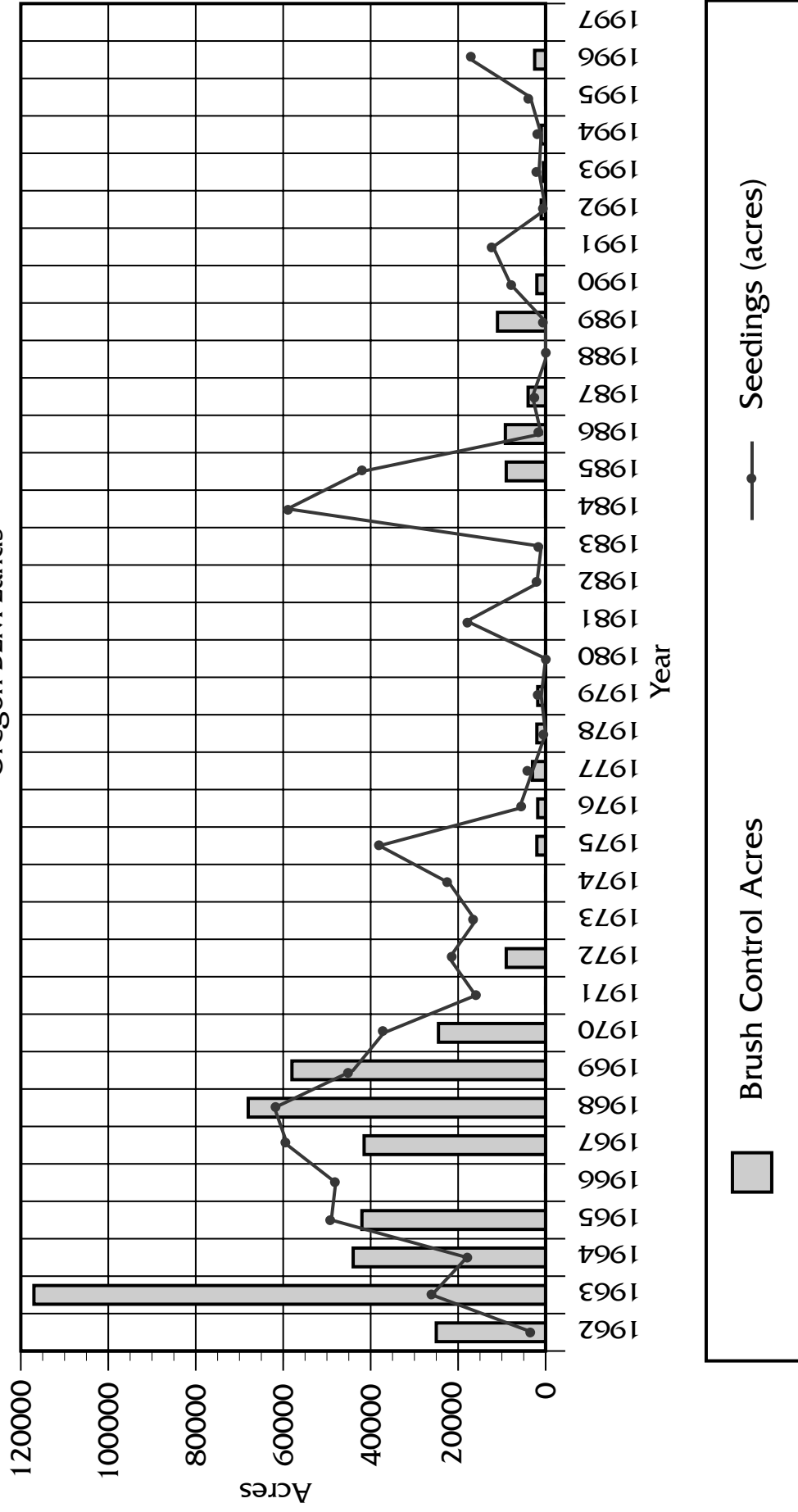
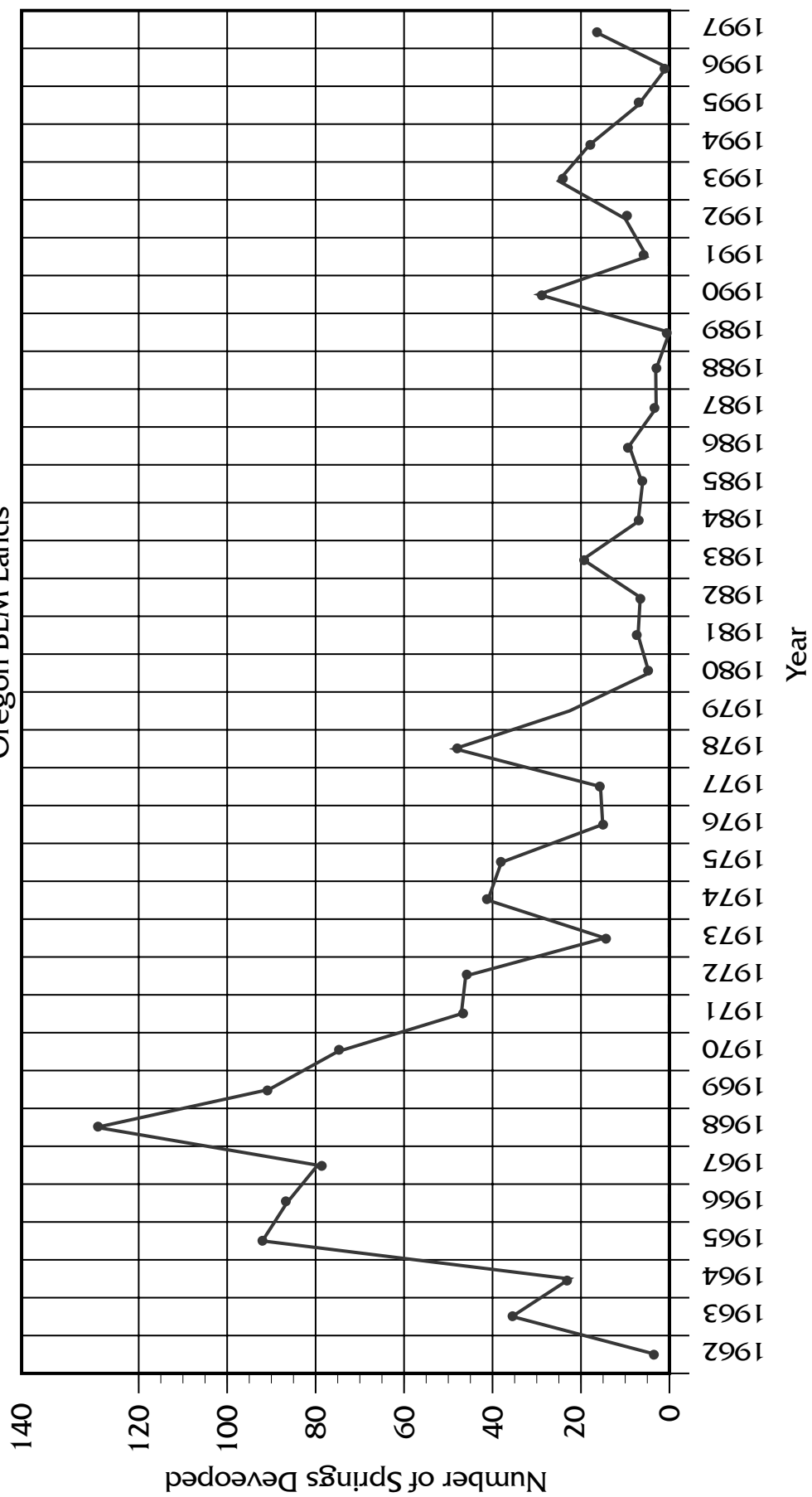


Chart 2
Springs Developed
Oregon BLM Lands



—●— Springs Developed

Chart 3
Miles of Pipeline and Fence
Oregon BLM Lands

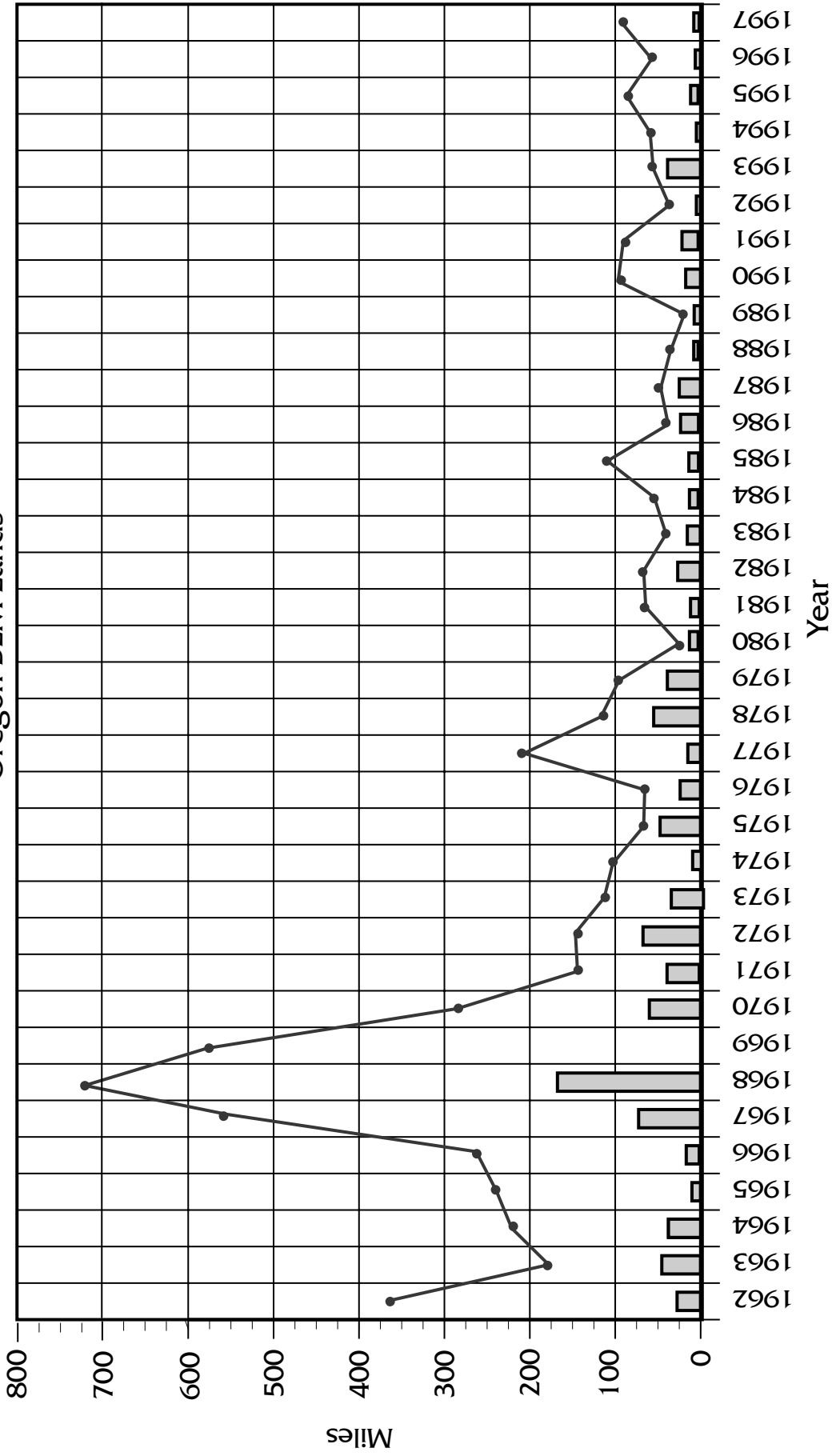
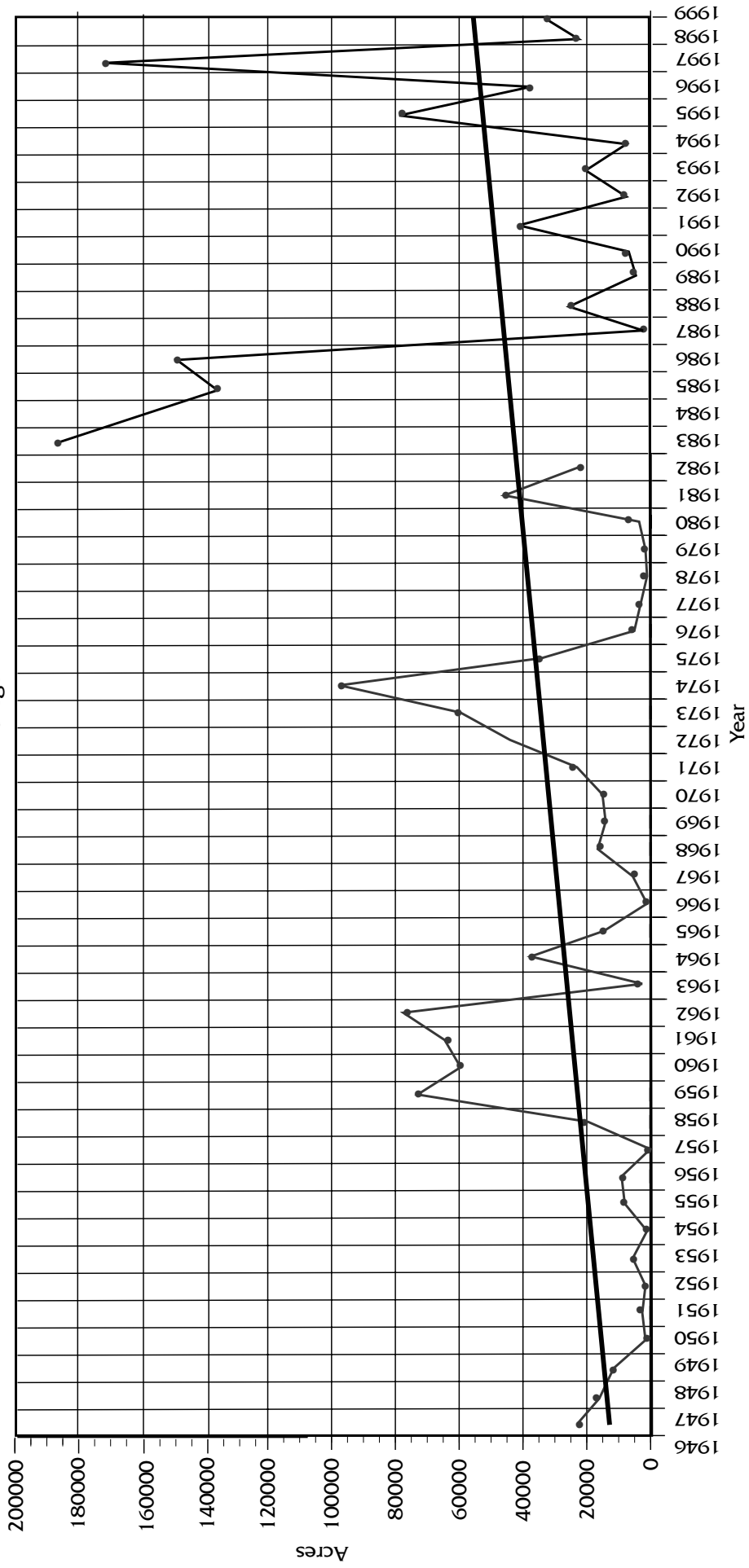


Chart 4
Acres of Non-forest BLM Lands Burned
Oregon



Acres Burned